

Remarks regarding the Claim Amendments

Claims 1-21 are presently pending in the application.

Claim 1 has been amended to include the limitation of Claim 2.

Claim 11 has been amended to include the limitations of Claim 12.

Claim 21 has been amended to include a limitation to an ATR probe.

Claims 3 and 13 have been amended to depend from Claims 1 and 11 respectively.

REJECTIONS

Claims 1, 10 and 21 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Mullins, et al., U.S. Patent No. 6,501,072 (31 Dec., 2002) (**D1**), in view of Chandy, et al., "A Novel Technique for On-line Measurement of Scaling using Multimode Optical-fiber Sensor for Industrial Applications", Sensors and Actuators B 71(2000), pp. 19-23 (**D2**). Claim 1 has been amended to include the content of Claim 2. Claim 10 depends from Claim 1. Claim 21 has been amended to include a limitation to an ATR probe which is analogous to Claims 2 and 12. It is the Applicant's position that Claims 1, 10, and 21 are now allowable in view of D1 and D2. In view of the effect of the amendment however, these claims will also be discussed in traversing the rejections of Original Claims 2 and 12.

Claims 2-9 (and constructively Claim 1, 10 and 21) stand rejected under 35 U.S.C. 103(a) as being unpatentable over D1 in view of D2 and in further in view of Papanyan, U.S. Pat. No. 6,388,251 (14 May, 2002) (**D3**). In reference to Claims 2 and 3, it is the Examiner's position that D1 and D2 contain all of the claimed features, but do not explicitly disclosing an Attenuated Total Reflectance probe (ATR). The Examiner cites D3 as disclosing an optical device for use in analysis of formation fluids, and in which optical fibers lead from the probe into the optical assembly (col. 6, lns. 3-4), and which suggests the use of an ATR probe for analysis of borehole fluids (col. 3, ln. 65 to col. 4, ln. 1). The Examiner further states that D1 and D2 are analogous art, since they are from a similar problem solving area, in that each involves measurements of precipitates and the scaling resulting therefrom and the motivation for combining the references would have been to gain the benefits of the ATR probe for analysis of the formation fluids. Accordingly, it would have been obvious to those skilled in the art to combine the references, at the time of the invention, in order to obtain such benefits.

From the rejection of Original Claims 1, 10, and 21, it is the Examiner's position that D1 discloses a system for determining the precipitation onset of asphaltenes in a formation fluid (i.e.

petroleum) by means of varying pressure, and measuring the size of the particles (col. 2, lns. 23-29) and that D1 also determines the size of the particles by using known measured refraction properties of the substance, and thus from the optical density, determining the size of the particles (col. 5, lns. 6 1-63 and col. 6, lns. 1-36). Further, the Examiner states that D1 subjects the samples to light in both the visible range from approximately 400 nm to the JR rang up to and beyond 1500 nm (col. 5, ins. 30-34). D1 introduces optical fibers 34 as one means to provide measurement (col. 4, in. 31 and Fig. 2). The Examiner concedes that D1 does not determine the onset and rate as a function of changes in the refractive indices. The Examiner cites D2 for disclosing that an optical fiber sensor can measure the scaling in aqueous solution in real-time, by measurement of the refractive index changes at the end of said fiber (p. 1, para. 1 and 2). It is the Examiner's position that the motivation for combining the references would have been to gain the benefit of real-time in-situ analysis features from D2, and incorporate said features into analyzing oil precipitates as in D1 and that it would have been obvious to those skilled in the art to combine the references, at the time of the invention, in order to obtain such benefits.

In reference to Original Claim 10, the Examiner states that cleaning, calibrating, inserting and extracting probes in the context of in-situ measurements has been well known in the art, and as may be acknowledged by the commercially availability of equipment for such purposes as cited by Applicants.

In reference to Original Claim 21, the Examiner states that D1 discloses a system for determining the precipitation onset of asphaltenes in a formation fluid (i.e. petroleum) by means of varying pressure, and measuring the size of the particles (col. 2, lns. 23-29). D1 also determines the size of the particles by using known measured refraction properties of the substance, and thus from the optical density, determining the size of the particles (col. 5, lns. 6 1-63 and col. 6, lns. 1-3 6). D1 introduces optical fibers 34 as one means to provide measurement (col. 4, ln. 31 and Fig. 2), and does so in the form of a probe (see Fig. 1). However, D1 does not determine the onset and rate as a function of changes in the refractive indices. D2 discloses that an optical fiber sensor can measure the scaling in aqueous solution in real-time, by measurement

of the refractive index changes at the end of said fiber (p. 1, para. 1 and 2). D1 is also cited by the Examiner as disclosing an electronic and processing 94 unit 18 (see Fig. 1).

In regard to the wavelength ranges recited in Claims 4-9, the Examiner states that D1 explicitly subjects the samples to light in both the visible range from approximately 400 nm to the IR range up to and beyond 1500 nm (col. 5, lns. 30-34), therefore, the ranges 400-1500 nm in Claim 4 are within the disclosed range of D1. The Examiner further states that the other ranges in Claims 5-9 represent non-critical limitations. The Examiner concludes in the alternative that these ranges would have been obvious to those skilled in the art at the time of the invention or it is not inventive to discover the optimum or workable ranges by routine experimentation.

The Claims of the present invention are not obvious over the cited prior are because the combination of references: D1, D2, and D3; do not disclose all of the limitations of Claims 2-9 (and 1, 10, and 21). Turning first to D3, the independent claims now all contain a limitation to an ATR probe. The probe disclosed in D3 is not an ATR probe and the difference is important in regard to the present invention. In the practice of the present invention, the entire probe surface is used to detect the presence of scale and its rate of formation. An ATR probe has a specific and generally trapezoidal geometry that allows a beam of light to enter the probe and bounce between the surface in contact with the sample not once or twice but many times. The total reflectance probe of the reference has a geometry allowing only a double bounce. The geometry of the ATR probe allows for the use of a much large part of the surface of the probe thus greatly increasing the ability of the probe to detect the beginning of scaling.

The D3 reference distinguishes between its total reflectance probe and the ATR probe of the present invention. In the background of D3, ATR technology is described as prior art and criticized as being insensitive of the presence of small particles in the fluid (at column 4, lines 38-40). One of ordinary skill in the art would not have been motivated to experiment with an ATR probe in view of the D3 reference's disparaging characterization of the ATR technology. In view of the fact that D3 does not disclose the use of an ATR probe in such a way that one of

ordinary skill in the art of testing for scaling in an oil well would have been motivated to combine D3 with D1 and D2, the subject claims are not obvious over the combination of D1, D2, and D3.

It is also the position of the Applicants that the D1 reference, either alone or in combination with the other references, does not serve to render the present invention obvious. D1 is directed to asphaltenes. Asphaltenes constitute a general class of aromatic-type substances which are defined on the basis of their solubility. Asphaltenes are soluble in carbon disulfide but insoluble in light alkanes such as n-pentane and n-heptane. Asphaltene molecules carry a core of stacked, flat sheets of condensed (fused) aromatic rings linked at their edges by chains of aliphatic and/or naphthenic-aromatic ring systems. The condensed sheets contain NSO atoms and probably vanadium and nickel complexes. In short, asphaltenes are the non-volatile, high molecular weight fraction of petroleum.

The claims of the present invention are directed to scale. Scale, as set out in the present application is formed from ions including calcium and barium, but sodium, carbonate, bicarbonate, chloride, sulfate, and strontium are also recognized as scaling species. The most common speciations of these combined scaling ions are: calcium carbonate, calcium sulfate, barium sulfate, and strontium sulfate. In addition, there are less common scale species, such as calcium fluoride, iron sulfide, zinc sulfide, lead sulfide, and sodium chloride.

A major distinction between the D1 reference cited by the Examiner and the present Application is that the D1 reference is directed detection of precipitation of an organic compound while the present application is directed toward the detection of precipitation of an inorganic compound. Within the field of chemistry, there is probably no other division that is as basic as the division between the organic and inorganic fields. Inorganics do not often lend themselves to conventional absorptive analysis. For example, IR spectroscopy is particularly ineffective in qualitatively analyzing inorganics, but is often the first choice when identifying an organic unknown. Similarly, atomic absorption (AA) or inductively coupled plasma spectroscopy (ICP)

are the methods of choice for determining qualitatively and quantitatively the levels of certain inorganic species while being useless for most organic compounds. In view of this, D1 could rise to the level of at most suggesting that an experiment might be in order but could not give one a sufficient level of assurance of success to be sufficient to render the present invention obvious.

The D2 reference does not render the present invention obvious. The D2 reference is a study relating to the use of plastic optical fiber sensors in industrial recycle water. Specifically, this study dealt with scaling in cooling water (implied throughout the document but explicitly stated at page 20, second paragraph of second column). There can be no comparison between the subject cooling water of the D2 reference and the production fluid of the present Application. The cooling water is roughly ambient in temperature and includes very little of anything else but water. Minerals and treatment chemicals are known when present. There are no problems with opacity, organic interference, co-precipitation of paraffins and asphaltenes, not to mention the fact that the fiber optic fiber probes do not have to operate at the high pressures and temperatures found downhole. Production fluid can consist of many components including water, almost any soluble mineral, natural gas, methane hydrates, drilling fluids, and petroleum in all of its many possible components. One of ordinary skill in the art of working with downhole fluids would not be motivated to have combined the D2 reference with its relatively simply analysis matrix to the problem of detecting and predicting scale in an oil well.

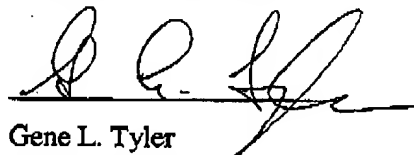
The Examiner also cites U.S. Patent No. 4,282,929 to Krajicek (D4) in rejection of some of the remaining claims. It is the Examiner's position that the D4 reference teaches that additives can be added downhole to stop the formation of scale. The Applicants do not deny that the use of additives to abate scale is known. It is the use of these additives in conjunction with the other elements of the Claims of the present invention that the Applicants respectfully represent to be patentable.

SUMMARY

In order for the claims of the present invention to be obvious, it is necessary that the references cited for that purpose have suggestion within them to make the combination. It is also necessary that the combination be such that one of ordinary skill in the art, in making the combination of the references, has a reasonable expectation of success. It is the Applicants' position that the one of ordinary skill in the art would not have been motivated to make the combinations of art cited by the Examiner. To the extent that an artisan would have considered such references, they could have risen to the level of obvious to experiment and no further. The prior art patentees in D1 and D3 were attempting to solve problems other than scaling. There is no teaching that asphaltenes can be used as a model for scaling. There is no teaching that detecting scaling in cooling tower recycle water can be a model for detecting scaling downhole. D3 expressly teaches away from employment of ATR technology and one would not be motivated to use that which is expressly discouraged. The Claims of the present invention to the use of an ATR probe in detecting and predicting scale are not obvious over the art cited by the Examiner

The Examiner is requested to withdraw his rejection of the Claims as amended in view of the above arguments. Allowance of Claims 1, 3-11, and 13-21, all of the remaining claims, is respectfully requested.

Respectfully submitted,



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